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Autobiography Of Proteins In Nutrition

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AUTOBIOGRAPHY

of

PROTEINS IN NUTRITION

by

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PREFACE

The proteins constitute a very important phase in the study of nutrition. Proteins are as closely related to nutrition as microscopes and bacteria are related to the study of bacteriology. Without microscopes the study of bacteriology is incomplete and similiarly a course in nutrition is incomplete if the function of the proteins are not stressed.

One of the main aims of teaching Home Economics to girls is to prepare them with a thorough knowledge of nutrition. When speaking of nutrition we usually have in mind some type of food that nourishes our bodies or prehaps, just food in general. But more important than types of food are their compositions and the benefits derived from them when they are metabolized into the body.

In view of the fact that proteins are of a very complex nature, I have attempted to classify the very particular kinds of protein, in order that the reader may get a clear chemical concept of the more complex proteins, and that the part which the proteins play in nutrition may be understood.

The main thoughts to be kept in mind while reading this discourse are: "what type of individual am I?","Is my protein intake great enough or is it too great?","Am I in immediate danger of being the victim of any disease due to Mal-nutrition?" Are my meals properly balanced in proportion to the type of work in which I am engaged?"

The aim of this discourse is to acquaint the reader with the chemical and nutritive knowledge of proteins, that have been investigated and thoroughly experimented in the field of nutrition, in order to bring to light the truths about the proteins, which otherwise would not have been known.

The proteins constitute what is known as the nitrogen compounds of food materials. Since the majority of the proteins consist of an average of sixteen percent of nitrogen, the protein content of food is usually estimated by determining the nitrogen and multiplying the percentage of nitrogen found by six and twenty-five hundreds. The nitrogen molecule of the proteins is very important because it keeps up body equilibrium.

The proteins are of two sources: Animal and plant, although synthetic proteins have been made in the laboratory.

The proteins, according to the American Physiologiscal society and the American Society of Biological Chemist, are divided into simple proteins which yield only Amino-Acids or their derviatives on hydrolysis. The first of the simple group of proteins to be discussed is the Albumins:

Albumins are simple substances soluble in water, dilute acids, and alkalies. They coagulate upon heating provided a nuetral salt like sodium chloride is present. If Albumins are freed from salts they do not coagulate when boiled. The solution may be completely precipitated by saturating it with ammonium sulphate or sodium chloride followed by acetic acid.

Egg albumin is found in the white of the egg to about twelve percent. It may be evaporated in thin films at ordinary temperature without losing its transparency or solubility in water.

Milk albumin is found in milk of various animals in amounts from one-half to one percent. It also remains in the whey after the coagulation of the casein which may be caused by rennet. Its points of coagulation ranges from 72° to 84° F.

In laboratories egg albumin is the most commonly used of all the proteins, to illustrate the protein properties in general. Experiments in nutrition have shown that certain animals have maintained normal growth with an adequate diet of Carbohydrates, fats, minerals and egg albumin as the only protein food.

Another type belonging to the simple class of proteins are the globulins. The globulins are insoluble in water but soluble in dilute solutions of salts, like sodium chloride, ammonium chloride and sodium sulphate. The globulins in solution coagulates on boiling and are completely precipitated by saturation with ammonium sulphate.

According to Sherman, in his Chemistry of Food and Nutrition serum and muscle globulin are found in the blood, edestin, in wheat, phaseolin in beans, legumin in peas, vignin in cow peas, tuberin in potatoes, amandin in almonds, excelsin in Brazil nuts, arachin and conarachin in peanuts.

A special group of protein has been found by Sherman known as the Alcohol-soluble, which only devotes that they are dissolved in strong solutions of alcohol. Gleadin, protein of wheat, zein protein of corn, and hordein, of barley are chieftly the alcohol soluble proteins.

Albuminoids are simple proteins which are partly free from phosphorous and yield, when decomposed by acids, or allowed to putrify, amino acids which are soluble in dilute alkalies and acids.

Another branch of albuminoids are the coagulated albuminoids which occur in animal and vegetable tissues and liquid secretion. Coagulated albuminoids are formed by heating neutral or slightly acid solutions of albumin. The coagulated albuminoids are insoluble in water, dilute acids, and alkalies. If acted upon by gastric or pancreatic juices they are converted into peptones, at a body temperature.

Albuminoids, if present in a solution, turn yellow when treated with concentrated nitric acid.

Glutelins, which belong to the simple protein group are found in cereal grains. The most commonly known cereals in which they are found are glutenins and gliatins, of wheat flour. These two kinds of proteins constitute what is known as gluten, which gives elasticity to flour dough. Glutenin and glaidin together makes up the total percent of protein present in the wheat kernel.

In 1874 Protamines were discovered by Miescher. A basic substance in the salmon fish was isolated by Miescher which he called protomines. His investigations were continued by Kossel, who made the protamines into one of the best known groups of albumins. The protamins form a well defined group which differ considerably from most of the other albuminous groups. They do not contain sulphur, very little carbon, but more nitrogen than any of the other albumins.

According to Kossel, in his chenistry manuel, the protamines are composed of the following amino acids, such as analin, serin, amino-valerianic acid, leucin, ornithin, lysin, histidine, tryrosin, urea, and tryptophane.

The radicals upon which protamino are built may be as numerous as they are in other albumins. Protamins are considered the simplest of all albumins.

The protamins resemble histones because they are precipitated from alkaloidal reagents not only from acids but also from meutral solutions, but since the protamins are stronger bases than histones they are precipitated from alkalin solutions.

Histones are albuminous substances of a simple type, which possess a relatively high percentage of basic radicles therefore rendering it basic rather than acid. For this reason histones are precipitated by alkalies which constitute their most remarkable property. They are very soluble in acids, and are opposite of such acid albumins as the globulins and caseinogens.

According to Mann the first histone was isolated by Kossel from the red blood corpuscles of the goose. Another histone was extracted by Lilienfield from the leucocytes of the thymus. The albuminous radical of hemoglobin or globin is also held to be a histone, although it differs in its reactions from the other histones.

Histons are precipitated from their watery solutions by ammonia. This reaction is the most important because it led originally to the discovery of the histones. In excess of ammonia the histones are soluble and they are even more readily dissolved by an excess of free alkali. The amount of ammonia required to precipitate differs for the individual histones.

Histones are coagulated by boiling only in the presence of salt. Though even then they are not completely coagulated for if the precipitates be dissolved in acids and be nuetralized, they remain in solution. This shows that they were not converted into acid albumin, and for the same reason they are again precipitated on being heated. Histones resemble acid-albumin by being precipitated from alkaline, neutral and acid solutions by the addition of small amounts of salts.

Histones are low in their sulfur content but contain a high percentage of nitrogen.

The coagulated proteins are those which are a little more complex than the simple albumins. They are made up of one or more radicals besides nitrogen. The first of this series to be discussed is the nucleo-proteins.

The strongest possible proof for the existence of nucleo-proteins according to Gustor Mann, is by means of an historical study of the distribution of iron and phosphorus by micro-chemical tests.

It is therefore regarded as chemical individuals which form a special group of albumin. It is admitted by Kossel that precipitates which are formed by bringing albumins and nucleic acids together closely, resemble the naturally-occuring nucleo-proteins and that the property of nucleic acids to form insoluble precipitates with albumins, making the isolation and investigation of nucleo-proteins. For this reason the nucleo-proteins are even less known than the simple albumins.

The nuclcic acid is linked to the albumin in the following manner: The albuminous radicals to which the nucleic acids is united in the tests of fish are the protamins and histons. In the leucocytes or white blood corpuscles, of the thymus, and in the nucleated red blood corpuscles, nucleic acid is also linked to the histone radical.

The nuclcic acid is linked to the albumin in the following manner: In nucleo protein of the pancreas a dissociation by acids analogous to that occuring with the nucleo-histon of the thymus, cannot be observed for the pancreas nucleo-protein when boiled in neutral solutions dissociate into albumin and nuclein.

Nucleo-proteins are decidedly acid, soluble in water and in salt solutions. They are precipitated by acids and with excess, they pass into solution again. They give all the color-reactions of the albumins and are precipitated by the ordinary precipitating agents.

On digesting nucleo-proteins with pepsin plus hydrolhloric acid, the albumin portion breaks up into albumoses and peptones, while the nuclein is precipitated. This property, according to Mann in his chemistry of the Proteids, of giving a precipitate with pepsin-hydrochloric acid let originally to the discovery of the nucleo-proteins by muscher and Plosz. This constitutes one of the chief characteristics, the others being their phosphorus and iron content, and in the presence of purive bases.

Another member of the conjugated group of proteins to be discussed are the glyco-proteins.

From its name glyco- it might be related some manner to the carbohydrates. The first well defined carbohydrate-compound isolated from an animal tissue was glycosamin, which Ledderhose prepared by boiling the shells of lobster claws in concentrated hydrochloric acid.

According to Gustav Mann, the glyco-proteins are albuminous substances, amongst the dissociation products of which is found a carbohydrate or the derivative of a carbohydrate . The carbohydrate portion is an unknown poly-saccharid, which does reduce, and the amino group is not free. On being boiled with alkalies or acids it gives rise to glucosamin.

Glyco-proteins have been sighted as being closely related to Mucino and egg albumins. Elichwald was the first to observe that a reducing substance may be separated from mucin, and that mucins are composed of an albumin plus a sugar radical. Mann's investigation proved that mucins contain no phosphorus and yield a reducing substance on being boiled with acids, and that glyco-proteins which are so closely related to mucins, contain a relatively large percent of sulphur.

Glyco-proteins are readily dissolved in excess of mineral acids. They are soluble in ammonia and in alkali-carbonates. An excess of alkali-carbonates quickly decomposes glyco-proteins.

Since phosphorus is essential to all the tissues of the body, the phospho-proteins are important in forming cell nuclei.

The phosphoproteins are found chieftly in casein and ovo-

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vitellin or egg yolk. In ovovitellin a very important amino-acid is found which is the only amino-acid that is composed of sulphur, which is known as cystine and is not replaceable by any other of the amino-acids. Hemoglobins are the last group of the conjugated series to be discussed here. They are closely related to the chromo-proteins, a class of albumin and coloring matter. The hemoglobins give cloring to the blood. According to experiments made by Sadtler and Coblentz, the parent substance of these compounds is oxyhemoglobin, as the compound of hemoglobin and oxygen are combined in arterial blood. Oxyhemoglobin is obtained from the blood of man and some of the lower animals.

Hemoglobin, being composed of an albuminous radical and a non-albuminous iron, containing nucleus, produces much interest, especially in nothing how the two fractions act upon each other so as to prevent their giving the reaction which they otherwise would give.

A more complex group of proteins are the derived proteins which are formed through changes brought about by hydrolysis without any alterations of the protein molecule. Albumoses and peptones belong to this group.

Pepsin in dilute hydrochloric acid solutions, and trysin in alkaline solutions, both have the power of peptonzing proteins.

Albumoses are the first products of the action of enzimes, upon protein material, and the continuation of the action changes them into peptones.

The two classes of albumoses and peptones may be distinguished by the addition of potassium ferrocyanide to acetic acid solution. Albumoses are precipitated while peptones are not.

There are two kinds of albumoses, anti-albumose and hemi-albumose. Each of the twi has a corresponding peptone, which is named similiar to the two albumoses. The first of these peptones cannot be further changed while the latter is changed by trypsin into leucine and tryosine which are two very important amino-acids.

Albumoses are again divided into primary and secondary albumoses. The primary resembling the albumins bud precipitated by sodium chloride which separates them from the secondary albumoses.

Kühne's researches have laid the foundation stone for the present knowledge of albumoses. He showed that pepsin breaks up albumoses.

Albumoses and peptones are so closely related that they can not be salted out. They only give a limited precipitation test. Considering the various color tests, the peptones constantly give the biurel reaction.

Peptones have a physical appearence like albumoses. Beyond the stage of peptones there are substances which are built up of two or more amino acid radicals. These substances are the peptids.

It had been assumed by Kühne that the digestion of pepsin only proceeded to form peptones, but Zinz and Pick showed that after precipitating albumoses and peptones, even if digestion had been going on for a short time, that over one-half of the nitrogen was in solution in some non-protein form. It might have been thought that pepsin acted similarly to trypsin, but it is shown that pepsin works more slowly, and that it gives rise to amino acids after prolonged peptic digestion.

The peptones after absorption into the blood are capable of being reconverted into its original protein material.

Having classified the proteins from a chemical standpoint, it is also important that their end products be discussed, which are the amino acids.

The amino acids are the end products of protein digestion. They are absorbed into the blood, and are carried in this form to the tissues, and are taken up in order to build up new and worn tissues.

The amino acids that are of particular interest and importance are those which are essential to growth and maintenance in the young. They are tryptophane, alanine, cystine, histidine, tryosine, lysine, proline, glycine, and phenylolanine.

Tryptophane is absolutely necessary for life and cannot be manufactured in the body cells. Alanine is contained in all protein foods. Glycine in manufactured in the body cells and does not constitute all protein foods. Cystine is the only sulphur producing amino and no other amino can be substituted in its place. Lysine and proline are absolutely essential for growth but not necessary for maintenance. Histidine is indispensible for without it life is impossible. It is not manufactured in the body cells, but must be contained in the protein food material. Tryosine and phenylolanine are similar in composition, and one may be substitued for the other in the diet.

Each of the above mentioned amino acids are made up of separate compositions. The most important phase of any of the amino acids depend upon whether they promotes growth or only substains maintenance.

Amino acids play an important part in protein metabolism, because they are involved in the hydrolysing process of proteins.

The amino acids, in the process of protein metabolism, pass through the intestinal wall and into the blood of the portal vein, unchanged. They are carried through the liver and into the blood and general circulation of the blood, which distributes them to all portions of the body. They are absorbed from the blood into the tissues. The tissues then synthesizes the newly received amino acids into types of proteins needed by the particular tissues. Aminos that are not used in synthesizing protein are broken down or deaminized.

Van Slyke's experiments shown that the blood contains amino acids at all times, and that the tissues are not free from them even after fasting for a certain length of time, on the other hand, higher protein foods taken into the body does not result in great accumilation of amino acids in the blood.

All the observations confirm the view that amino acids are the normal intermediary products in the building up and breakin g down of body protein, and that any large storage of notrogen in the body must be due to the formation of body protein, and not mere accumilation of free amino acids.

It has been previously stated that proteins are avilable from two sources: Namely animals and plants.

The proteins obtained from animal source, like the type which contains the best quality amino acids which are the growth producing aminos like histidine and tryptophane. Foods which contains the amino acids that produce growth and keep up maintenance are known as the complete protein, and are only obtained from animal sources.

Proteins obtained from plant sources are deficient, in that they lack the growth producing amino, but contain only those necessary for adult maintenance. Such proteins are partially incomplete. A good example of an incomplete protein is given by Mary Swartz Rose in her foundations of Nutrition". The example was that zein a corn protein was fed to one laboratory rat and casein was fed to another rat for a period of about six weeks. The zein-fed rat did not grow large, while the casein-fed rat grew to a normal size. Later the zein was analized and it was found to be lacking in essential amino acids such as; lysine and tryptophane.

When there is diet deficiencies there are always abnormal results. When a body is under nourished its resistence is exceptionally low, which makes it susceptible to disease. On the other hand, when a diet is efficient, and when the intake of protein is exceedingly greater than the intake of carbohydrate, the body is danger of mal-nutritional diseases.

Optimum protein in the diet along with adequate carbohydrate forces the protein to act in the same manner as the carbohydrate. Because there is not enough carbohydrate in the body to fullfil the energy needs therefore protein has to act as an energy generator.

This process is carried on in the following manner: The protein gives up its carbon, hydrogen, and oxygen to be burned to furnish energy, leaving only the nitrogen molecule which will not submit to burning. The nitrogen molecule splits up forming ammonia, which with carbonic acid coustantly being formed in metabolism units with ammonia forming ammonium carbonate. This ammonium carbonate after losing two molecules of water yields urea. This urea is free and is constantly passing through the liver and kidneys, uniting with certain mineral salts and forming stable ammonium salts. The later causes nutritional diseases of the liver and kidneys.

In order to avoid such disaster, it is necessary that the body's intake of carbohydrate and fat be sufficient, enough to take care of the total energy requirment, without having to draw upon protein for its energy needs.

The percentage of protein intake depends largely upon the age of the individual, and his general physical condition.

Since age is an important factor in protein intake, the growing child should be considered here. The child's demands for its building material is very great, because it needs protein for growth as well as maintenance. The child is developing new tissues and firm bones. In order for this to be done, the best quality of complet proteins should be administered. For this reason milk is given to children, in large quanities. The growing child is able to keep on growing with a quart of milk a day, added to the other wise adequate diets.

According to Mary Rose in her "Foundation of Nutrition", the growing child's protein intake should constitute fifteen percent of the total calorie intake per day. With regard to the healthful adult, the protein requirement is much lower. Because the adult has reached maturity. Growth therefore is discontinued. Protein is only needed then to keep up maintenance.

The larger the individual the greater is his protein intake. A large person is said to need a greater intake of protein for he has more muscle tissues to maintain in a healthful condition. The protein is made use of wholly, as the nitrogen is partly, used by the body and a normal percentage is eliminated as waste material. The carbon, hydrogen, and oxygen is burned and is used for energy only when their is a deficency in the carbohydrate and fat. The intake should be sufficiently great to supply the body with the necessary fuel.

Convalescent adults whose bodies are in need of more or less repair, should have complete proteins in order to rebuild necessary tissues.

The nursing mother needs a large supply of complete proteins in order to noursh her young, and to keep up her own boidly maintenance.

Sedentary individuals require very small percents of proteins just enough to keep up body maintenance, and a low nitrogen equilibruim.

SUMMARY

It has been shown in the previous discussion that the proteins are tissue building substances made up of carbon, hydrogen, and oxygen plus nitrogen. They are very complex substances and have never been thoroughly known regarding their chemical constituents, but it is known that life is impossible without the proteins.

Proteins are divided into simple, conjugated and derived. The simple proteins, or hydrolysis yield only amino acids, and those belonging to this group are: Albumins, globolins, albuminoids, histones, and protamins.

Albumins are the most commonly known and is found in the whites of egg, Globulins are found in the wheat germ; Albuminoids which form membrance of many glands of the body and are strictly of an animal characteristic: Histones are considerable important as food and are derived from the hemoglobulins of the blood; Protamins are noted for possessing strong basic amino acids which are of major importance in nutrition.

The conjugated proteins contain besides the protein molecule, one or more substances other than a salt. The conjugated proteins include Nucleo-proteins, glyco-proteins, phosphoproteins and hemoglobins.

The Nucleo-proteins are compounds of protein molecule and nucleic acid. Foods that contains nucleo proteins provides nurishment to the thymus gland, and build up all of their worn tissues. Glyco-proteins which are made up of a protein

molecule and are commonly found in casenogen of milk and in covovitellin. The hemoglobins are a combination of hematin and ptotein, the hematins are subtances which produces redness in the blood.

The third group of proteins are the derived proteins which are formed through slight changes of the protein molecule caused by hydrolysis. Included in this group are: Albumoses, peptones, and peptids. Albumoses are the first products of the action of enzimes upon protein material. Peptones are products of further protein digestion, and they cannot be totally precipitated or salted out. Peptids are made up of two or more amino acids and produce peptones on digestion.

All proteins are broken down into amino acids before they are used by the body. If the protein is of animal sources the amino will be of very good quality, but if it is of plant origin, the amino acid will be of poor quality and will not furnish growth.

Those proteins, which produce growth in the young and are able to keep up body maintenance are known as complete proteins and are chieftly of animal source.

Protein of plant origin forms upon hydrolysis, amino acids which are insufficient in growth production and are poor sources of body maintenance. Such types of protein are found in vegetables and fruits.

Protein intake should be in smaller proportions than carbohydrate intake, because when protein is made to fundtion as a carbohydrate it causes deaminization of the nitrogen radical, producing poisonous substances in the system, which results in nutritional diseases.

The protein intake depends upon the age, physical conditions, and size of an individual.

An infant needs protein in order to grow. This is received from the mother. The mother should consume protein which would yield only complete amino acids.

Other individuals who need large percentage of complete proteins are Athletes, convalescents and growing boys and girls.

Sedentary individuals require only a small percent of complete protein to keep up normal health.

Since scientific experimentations have shown the vital importance of proteins to life and health and especially, the importance of proper protein diets, it seems to me that individuals should take an inventory of themselves. In that inventory of themselves, let each consider his age, and size and physical condition and then let his protein intake be in conformity with the above mentioned factors.

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